NAVAL MEDICAL FIELD RESEARCH LABORATORY

Vol. XIV, No. 4 March 1964

THE PREDICTION OF DISEASE

I. Identification of the Coronary Heart Disease Candidate
II. The Coronary Profile Score
III. The Role of the Computer

by

GEORGE L. CALVY, CAPT MC USN

Bureau of Medicine and Surgery, Navy Department

MR005.09-1160.1.1

CAMP LEJEUNE NORTH CAROLINA

MCBCL 1375(7)-8/61

Vol. XIV, No. 4 March 1964

THE PREDICTION OF DISEASE

I. Identification of the Coronary Heart Disease Candidate
II. The Coronary Profile Score
III. The Role of the Computer

by

GEORGE L. CALVY, CAPT MC USN

U. S. NAVAL MEDICAL FIELD RESEARCH LABORATORY
CAMP LEJEUNE, NORTH CAROLINA

Bureau of Medicine and Surgery, Navy Department
MR005.09-1160.1.1

Submitted by

GEORGE L. CALVY
CAPTAIN MC USN
Commanding Officer

SUMMARY PAGE

THE PROBLEM

To determine extent and distribution of "covert coronary heart disease (Gertler)" in males 30 years of age and over in the U. S. Marine Corps. To apply measures to prevent and/or defer overt expression of this disease.

FINDINGS

Evidence of involvement in varying degree in the sample studied thus far.

APPLICATION

A screening device to detect coronary atherosclerosis, a dynamic, reversible, metabolic dysfunction, in its early phases.

RECOMMENDATIONS

Modification of the annual physical examination for Marine Corps personnel, age 30 and over, and all personnel with the rating of E-4 and above, regardless of age, to include the coronary profile screening technique and to repeat the profile at biennial or triennial intervals (to be determined).

ADMINISTRATIVE INFORMATION

Bureau of Medicine and Surgery, Navy Department Research Project MR005.09, Task MR005.09-1160. This report is No. 1 on Subtask 1. Interim report. Approved for publication 18 March 1964.

The assistance of Dr. M. M. Gertler, N.Y.U. Medical Center; Captain J. R. Dineen, MC, USN, Division Surgeon, 2d Marine Division; HMCA J. W. Hamby, USN; and HM2 J. L. Cottingham, USN, is gratefully acknowledged.

Published by the U. S. Naval Medical Field Research Laboratory, Camp Lejeune, North Carolina.

FOR OFFICIAL USE ONLY

This restriction will be removed and the report may be released on 1 April 1964

I. IDENTIFICATION OF THE CORONARY HEART DISEASE CANDIDATE

Introduction

The concept that an individual may be marked as a potential victim for a certain disease, due to his possession of a type specific constitution, has intrigued observant persons since the days of the ancient savants, Hippocrates and others.

The modern era of investigation of disease proneness was ushered in with the founding of the Constitution Clinic by Dr. George Draper at Presbyterian Medical Center, New York in 1916.

Draper viewed the total person as one would in looking at a multi-paneled Oriental screen, across which was drawn a scene.[1] Inspection of one panel would signify little for it would yield only a segment of the whole. Thus the assessment of body type alone would be lacking the information to be obtained from observing the person in action (physiologically and psychologically), or from probing the recesses that would contain evidence of his resistance or susceptibility to (stress) infection. The gathering of evidence from all panels would be essential to gain an appreciation of the whole.

Dr. Draper arbitrarily chose four divisions, or panels, for evaluating the total being. These were:

I	Morphology	(Now assessed as a somatotype)	
II	Physiology	Function	
		Chemotype (Biochemical profile)	
III	Psychology	Mental	Patterns of response
		Emotional	
IV	Immunology	Susceptibility	To stress (infection)
		Resistance	

With this frame of reference and with establishment of the concept of the Unity of the Organism, the stage was set for further advance.[2] During the ensuing years more precise techniques became available and during the recent advent and refinement of the computer

art and science, the pace of scientific investigation and discovery has quickened.

This communication is a report of essential background and recent significant progress in the epidemiology of coronary atherosclerosis.

There is sufficient evidence available today to indicate that coronary heart disease has an incubation period just as do the well-known childhood infectious diseases, measles, mumps, etc.; however, in the case of coronary heart disease the incubation period may be 10 to 20 years. It has been shown further that coronary heart disease may be detected during the incubation period in nearly all such individuals. Once detection is made, the possibility of early and effective prevention becomes a reality.

Dr. Paul Dudley White draws attention to the devastating toll that heart attacks take in this modern society and he stimulates many physicians to study methods of preventing this dreaded disease. He is a pioneer in searching for clues which he hopes will eradicate this greatest killer of them all.

The Coronary Profile

In 1946 Dr. White, at the Harvard Medical School and Massachusetts General Hospital, appointed Dr. Gertler as executive officer of a project that sought to uncover clues to the identity of the coronary-prone individual. Their concept of the coronary-prone individual has now been validated by computer-assisted research and this story of medical progress is contained in Dr. Gertler's current book, "You Can Predict Your Heart Attack and Prevent It."[3] Eight pieces of information were gathered on 600 executive-type workers at a major New York Corporation in 1958 and put on a punched paper card and then fed into a computer. The computer returned 39 scores which were in the highly prone range. In less than five years impressive validation of the Gertler-White concept was accomplished when 38 of the 39 individuals suffered coronary heart attacks. Other leading corporations and the military (Navy-Marine Corps) are now utilizing this concept-technique to protect their high-risk members. What is the meaning and the application of this significant new information?

It clearly signifies the importance of preventive medicine and specific measures that will lower a man's diastolic blood pressure, his

cholesterol, his uric acid and thereby reduce his chances of having a heart attack.

An extraordinary amount of emphasis has been placed on blood cholesterol and, of course, this one factor carries considerable weight. It should be emphasized, however, that this is only one piece of the jigsaw puzzle that comprises coronary heart disease. There is considerable evidence at hand that other intermediate chemical substances manufactured by the body may be equally culpable in precipitating an acute coronary episode.

The writer, Director and Commanding Officer of the Naval Medical Field Research Laboratory since 15 April 1959, has been identified with research projects dealing with disease-prone individuals since 1942, first at Presbyterian Medical Center at the Constitution Clinic of Dr. George Draper 1942 to 1947 with Doctors Draper, Dupertuis and Caughey. There he became familiar with and interested in such disease-prone types as the individual with poliomyelitis, gall bladder disease, peptic ulcer and coronary heart disease.[4] During this period the creative mind of Dr. Draper introduced the tissue culture cell technique as a discriminant device. He was able to demonstrate individuality of the above types at the cellular level.[5] This observation, one of very fundamental significance, has been largely unnoticed.

Working on a parallel course at Massachusetts General Hospital, Dr. Menard M. Gertler, working in conjunction with Dr. Paul Dudley White, began their epochal study of coronary heart disease in the young adult male. Their monograph[6] was published by the Harvard University Press in 1954 and this marked a turning point in the history of the disease that was first clearly described by Dr. John B. Herrick in Chicago in 1912.

It became apparent through extensive investigation that atherosclerosis was not a necessary accompaniment of old age but that it could occur in the unborn babe. The disease assumed new dimensions as information was adduced to identify it as a dynamic, at times reversible, metabolic dysfunction.

Just a short time before Gertler and White's publication, the classical report on healthy young American soldiers killed in action in Korea demonstrated by autopsy studies that 77.2 per cent of this population, averaging 22 years of age, had significant coronary atherosclerosis.[7]

A great wave of criticism arose for it is known that the military diet contained enormous amounts of milk, butter, eggs, cheese, ice cream and animal fats.

The dairy industry felt the impact of this growing censure and strong denunciation and the consumption of dairy products declined significantly during the ensuing years. An unresolved question remained, "Was the military diet harmful?"

The author and Dr. Gertler have been associated since 1957 in cardiovascular research, first while Chief of Medicine at the U. S. Naval Hospital, St. Albans, New York where a five-year study was launched in 1958 to point out discriminating factors in the individuals who were stroke susceptible versus those who were coronary susceptible.

With the writer's transfer to Naval Medical Field Research Laboratory, Camp Lejeune in 1959, opportunity arose to study the military diet and the effect of exercise on various chemical constituents of the blood serum. To everyone's surprise, cholesterol scarcely budged nor did any of the other lipids, save triglycerides, show significant change but the answer was clear. Exercise consumes calories in the young 18-year-old recruit just about as fast as he can pour them into his digestive system.[8,9]

Interpretation of a significant rise (100% +) in triglycerides awaits completion of data analysis now underway. This could well be an adaptive "feedback" mechanism in response to the demands of exercise and/or a reflection of physical fitness.

At this juncture a series of studies on the effect of measured exercise on serum cholesterol, etc., during the taking of fat meals of saturated and of unsaturated fats, has been completed. These results were presented before the American Heart Association Conference on Epidemiology of Cardiovascular Disease at Chicago, Illinois, 1 February 1964.[10]

The art of forecasting disease proneness has come a long way since the early days of the Constitution Clinic, New York, where the philosopher-physician and prescient scientist, the immortal Dr. George Draper, held sway. Technological advances in science that he prophesied and the tremendous impetus derived from computer-assisted research have advanced the frontiers of knowledge.

In Draper's words, "There is no final formula, however, which can be generally applied in this matter of understanding 'the man within the patient.' But we believe that certain technical methods can be efficiently brought to the hard problem of appraising the nature of a given human being. Certain of these procedures have been set down. They have dealt with morphology, physiology, immunity and emotion, not as isolated criteria but as co-essentials in the vital whole. Like other creatures which have yielded their life secrets to biological inquiry, so will man's be disclosed by the threefold device of observation, correlation, and interpretation."[2]

II. THE CORONARY PROFILE SCORE*

In scoring the individual's coronary profile, eight factors are considered. Since these eight factors present fifteen million different possible combinations, it was necessary to rely on computer assistance to assign appropriate weights for each factor. The formula and derived data were contributed by Dr. Max Woodbury, Professor of Mathematics, New York University, in collaboration with Dr. Gertler and the New York University Computer Center.

Thus, scores for the following six factors were calculated and were assigned positive (+) values:

1. Family history (no history = 0; father = 14; mother alone = 20; sibling = 24; etc.)
2. Diastolic blood pressure (91 and over, and age)
3. Cholesterol
4. Uric acid
5. Diabetes (presence, duration or absence)
6. Body build (estimate of somatotype with reference to mesomorphy and other components)

---

* See scoring form (Appendix A)

The foregoing six factors have all yielded results showing a positive correlation with atherosclerosis. The remaining two factors correlate negatively with atherosclerosis and they are assigned negative (-) values:

7. Height

8. Phospholipids

By reference to Gertler's formula and tables, appropriate numerical values for a precise level of serum cholesterol, uric acid, diastolic blood pressure, presence or absence of family history of coronary atherosclerosis (angina, myocardial infarction, coronary insufficiency), presence or absence of diabetes, and the degree of mesomorphy can be quickly assigned. To this sum is added a mathematical constant of 898 and the total is calculated. From this is subtracted the sum of the values of the phospholipid level of the individual and his height. Let us assume that the first six factors plus 898 yielded a score of 1500 and the two negative factors of height and phospholipids totaled 1425. The resultant score would be 75, a value that would place the individual in the high coronary-prone range. On the other hand, if his negative factors totaled 1472, his resultant score would be 28, showing virtually no tendency toward his having coronary heart disease.

III. THE ROLE OF THE COMPUTER

The statistical method is used today in some phase of nearly every scientific investigation. Its value lies not only in revealing to the observer the validity of a question, but also in helping to explain the reasons for the validity.

Considerable progress has been made in the prediction of weather and in the tracking of a missile. These advances would have been of lesser magnitude without computer-assisted research.

Medicine, especially the area of preventive medicine, will increasingly rely on the fruits of the computer to give it sustenance and the vigor to breach frontiers. In advancing these frontiers we must exercise our talents and harness the computer's capability to provide us with information swiftly and accurately. No prophetic talent is required to envision further advances in the art and science of disease prediction.

BIBLIOGRAPHY

1. Draper, G.: Human Constitution. Saunders, Philadelphia, 1924.

2. Draper, G., Dupertuis, C. W., and Caughey, J. L., Jr.: Human Constitution in Clinical Medicine. Paul B. Hoeber, Inc., New York and London, 1944.

3. Gertler, M. M.: You Can Predict Your Heart Attack and Prevent It. Random House, New York, 1963.

4. Calvy, G. L.: Concepts of Constitutional Medicine. U. S. Naval Med. Bull., 49:825, September-October 1949.

5. Draper, G., Ramsey, H. J., and Dupertuis, C. W.: Variation in Behavior of Buffy Coat Cultures Among Individuals of Different Constitution Types. J. Clin. Investigation, 23:864, 1944.

6. Gertler, M. M., and White, P. D.: Coronary Heart Disease in Young Adults. (The Commonwealth Fund, Cambridge, Mass.) Harvard University Press, 1954.

7. Enos, W. F., Holmes, R. H., and Beyer, J.: Coronary Disease Among U. S. Soldiers Killed in Action in Korea. J.A.M.A. 152: 1090, 1953.

8. Calvy, G. L., Cady, L. D., Mufson, M. A., Nierman, J., and Gertler, M. M.: Serum Lipids and Enzymes. J.A.M.A. 183: 1-4, January 1963.

9. Calvy, G. L., Gertler, M. M., and Cady, L. D.: Serum Lipids, Enzymes, and Vigorous Exercise. Circulation, 28:651, October 1963, Part 2.

10. Calvy, G. L., Coffin, L. H., Gertler, M. M., and Cady, L. D.: Serum Lipids, Vigorous Exercise and High Fat Diet. (In press, Clin. Research, April 1964).

Appendix A

CORONARY PROFILE

(Plus additional unexplored data)
FILL IN EVERY SPACE POSSIBLE*
(A Medical Officer will execute this form)

No._____

Name_____

*Age (Insurance age)_____ Date of birth_____

SCORE

*1 + F. H. (Strokes, Infarction, Cor. Insuff.)_____

_____

*2 + Body Build (refer to age group, etc.)_____

*3 - Height (inches)_____ *Weight_____

4 - Phospholipids
5 + Cholesterol
6 + Uric Acid
} Fill in later

*7 + Blood Pressure (see chart) Diastolic_____

*8 + Diabetes (History of - seek F.H. of)_____

_____

+ Math. Constant 898 — 898

(Add #1,2,5,6,7,8; Subtract 3 and 4) — SCORE

Triglycerides
Glucose
Enzymes:
(a) Lactic Dehydrogenase (LDH)
(b) Malic Dehydrogenase (MDH)
(c) Isocitric Dehydrogenase (ICDH)
} Fill in Later

*Exercise_____ *Smoking_____

*Sleep_____ *Alcohol_____

*P.M.H. Frequency of illness_____

_____

*NOTE: Fill in each space marked by an asterisk (*).